of individual children, however, this trend apparently contributed only trivially to the overall decline in test scores.

A number of cross-sectional studies have found that children from single-parent households headed by women have lower average scores on a number of measures of intellectual development and achievement, including IQ tests, standardized achievement tests, and school grades. 5/ This association between number of parents present and achievement varies markedly from one study to another, however, depending in part on the characteristics of the children involved. For example, a recent nationally representative study found that the scores of elementary school children from two-parent households exceeded those of children from single-parent homes by roughly 0.13 standard deviation among whites and 0.20 standard deviation among blacks. 6/ In contrast, the corresponding differences among secondary school students were found to be negligible in a parallel study of that age group. 7/

The impact of the growing share of children living in single-parent households might be even less than these cross-sectional findings suggest, however, because the general problem of confounding is particularly acute in this instance. For example, school-age children in female-headed households are more than four times as likely as other children to be

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5. See, for example, E. M. Hetherington, K. A. Camara, and D. A. Featherman, "Achievement and Intellectual Functioning of Children in One-Parent Households," in J. T. Spence, ed., *Achievement and Achievement Motives: Psychological and Sociological Approaches* (San Francisco: W. H. Freeman, 1984); A. M. Milne, D. E. Myers, F. M. Ellman, and A. Ginsburg, "Single Parents, Working Mothers and the Educational Achievement of Elementary School Age Children" (Washington, D.C.: Decision Resources, unpublished, June 1983); D. E. Myers, A. Milne, F. Ellman, and A. Ginsburg, "Single Parents, Working Mothers and the Educational Achievement of Secondary School Age Children" (Washington, D.C.: Decision Resources, unpublished, June 1983); Sally Banks Zakariya, "Another Look at Children of Divorce: Summary Report of the Study of School Needs for One-Parent Families," *Principal* (September 1982), pp. 34-37; and D. Scott-Jones, "Family Influences on Cognitive Development and School Achievement," in E. W. Gordon, ed., *Review of Research in Education*, vol. 11 (Washington, D.C.: American Educational Research Association, 1984), pp. 259-304.

6. Milne and others, "Single Parents, Working Mothers and the Educational Achievement of Elementary School Age Children."

7. Myers and others, "Single Parents, Working Mothers and the Educational Achievement of Secondary School Age Children"; Zakariya, "Another Look at Children of Divorce."

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poor. 8/ In addition, minority school-age children are more than two-and-one-half times as likely as nonminority children to live in female-headed households. 9/ Much of the research showing lower achievement among children from female-headed households fails to control adequately for such factors, and several studies that have taken those factors into account have found that the apparent differences between children from female-headed and other households shrink as a result. 10/ How much of the apparent achievement gap between children from single-parent and two-parent families to attribute to that aspect of family composition itself remains a matter of controversy, and therefore how much one should expect trends in the percentage of children living in single-parent families to affect average test scores is correspondingly uncertain. 11/

Since the 1959-1960 school year, the proportion of children living in single-parent, female-headed households has grown from 9 percent to about 20 percent. 12/ (The proportion of children living in single-parent, male-headed households has also grown, but that percentage remains small--about 2 percent in 1984.) 13/ Although this trend was virtually uninterrupted until the last few years, the most rapid increase occurred between 1969

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8. Congressional Budget Office, "Poverty Among Children" (Staff working paper, December 3, 1984).

9. Based on Bureau of the Census, *Current Population Reports*, Series P-60.

10. Hetherington and others, "Achievement and Intellectual Functioning"; D. Scott-Jones, "Family Influences on Cognitive Development and School Achievement."

11. On the other hand, the cross-sectional studies quite likely understate--perhaps by a large margin--the impact of living in a single-parent household on the achievement of certain individual children. It is reasonable to assume that any effect on achievement increases with the time that children live in single-parent households, but cross-sectional data typically include little or no indication of that duration and therefore probably obscure the greater effects on children living in single-parent households for long periods. While such an understatement would be important in some contexts, it is not germane here, for the national trend data on household composition parallel the cross-sectional data in grouping children together regardless of the duration of their time in single-parent homes.

12. These percentages are from Bureau of the Census, *Current Population Reports*, Series P-60; they include only related children in families. Trends among school-age children have been similar in recent years, although the proportion in female-headed households is somewhat higher.

13. Department of Commerce, Bureau of the Census, *Marital Status and Living Arrangements, 1984*, Series P-20, No. 399 (1985), Table 4.

and 1977 and was thus roughly concurrent with the decline in achievement.14/ Taken alone, this timing suggests that the growing share of children living in single-parent households could have contributed to the achievement decline.

Because of the relatively small number of children directly affected by the trend, however, the growing proportion of children living in single-parent households could have contributed only trivially to the test score decline. The great majority of children remain in two-parent households, and their scores would not be directly affected. For example, between 1965 and 1979, the proportion of school-age children living in female-headed households increased by only about eight percentage points, leaving the scores of 92 percent of the students in those cohorts unaffected. If the effect of being in a single-parent home was to depress the test scores of affected children by an average of 0.15 standard deviation, this shift in household composition would have lowered the overall average test score by roughly 0.01 standard deviation. In contrast, declines in average scores in excess of a third of a standard deviation were not uncommon during that period. Moreover, in secondary schools--where the test score decline was typically largest--the contribution of this shift in household composition would be smaller yet or even nonexistent.

Family Size

The fertility changes of the baby boom and subsequent baby bust produced several changes in the composition of families that can be conveniently--if not entirely accurately--grouped together as changes in "family size." The baby boom raised the average number of children per family and the average birth order of children. 15/ The baby bust reversed both of these trends.

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14. The extent of temporal consistency is not fully apparent, because this trend cannot be linked precisely to birth cohorts and cannot be aligned with test score trends in specific grades. The trend data also provide no indication of the pattern of household composition experienced over time by affected children--for example, the ages at which children encounter various household arrangements--which is an important omission, since factors such as age appear to alter markedly the effects on achievement.

15. "Children per family" is used here to denote the average number of resident children under age 18 per family; families with no resident children under age 18 are not averaged in. Birth order refers to the sequence of births in a family; the first-born has an order of one, the second-born, two, and so on. "Average birth order" in a cohort is simply the average order of all children born in that year. If half are first-borns and half second-borns, their average birth order is 1.5; if a third each are first-, second- and third-borns, their average birth order is 2.0, and so on.

A well-publicized but still controversial hypothesis attributes a sizable share of both the decline in test scores and the subsequent rise to these changes. Indeed, one researcher used trends in birth order to predict quite accurately the time when SAT scores would start their upturn and has since offered predictions of trends in SAT scores past the year 2000. 16/

The prominence of this hypothesis probably stems less from the long-standing and copious research into the effects of family size on intelligence and achievement than from the striking concordance between trends in average birth order and SAT scores over the past two decades (see Figure A-1). Average birth order rose steadily from 2.4 to 3.0 between the cohort born in 1947 and those born in 1961 and 1962--almost exactly the cohorts that produced the decline in SAT scores. Both trends have since reversed themselves--birth order sharply, SAT scores more modestly.

The research as a whole suggests that family size could have contributed to both the decline and the rise of test scores. Despite the striking consistency between trends in birth order and SAT scores, however, changes in family size appear to account for only a modest share of the trends in test scores.

This conclusion, however, does not represent a consensus in the research literature. Indeed, research on this topic is currently characterized by vehement disagreements, and the available cross-sectional research and data on temporal consistency are used to support a wide range of contradictory positions. For these reasons, this analysis gives special weight to a few studies that directly estimated the contributions of family size to recent achievement trends by comparing the family characteristics and test scores of individual students in some of the cohorts responsible for those trends. Those studies are described after the following synopsis of cross-sectional studies and temporal consistency.

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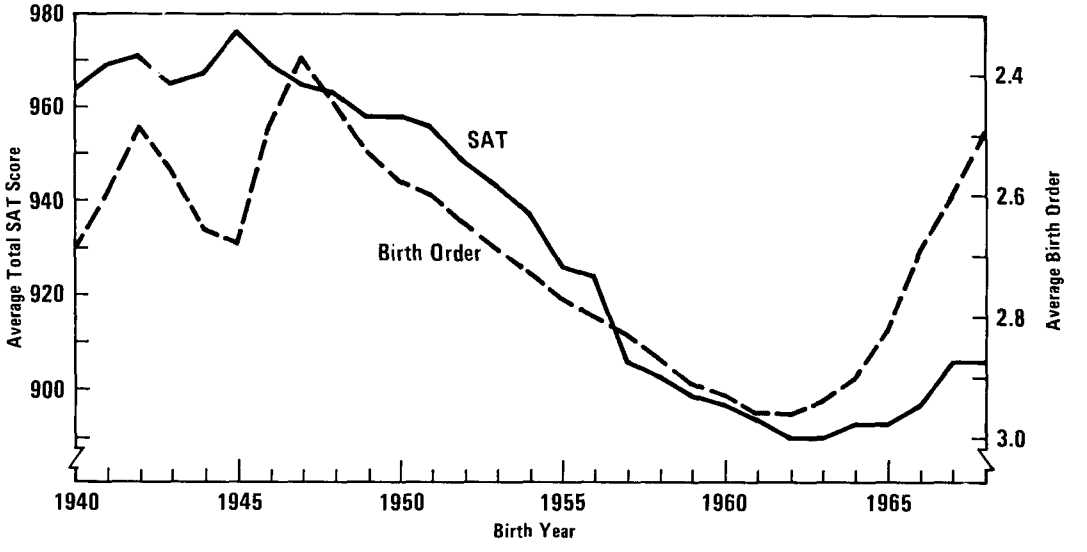
16. R. B. Zajonc, "Family Configuration and Intelligence," *Science*, vol. 192 (April 16, 1976), pp. 227-236, and "The Decline and Rise of Scholastic Aptitude Scores: A Prediction Derived from the Confluence Model," *American Psychologist*, vol. 41, no. 8 (August 1986), pp. 862-863. Whatever the impact of birth order on achievement, such a prediction assumes that all other factors affecting aggregate achievement will vary little over the coming years.

Figure A-1.

Average Total SAT and Average Birth Order (By year of birth)



SOURCES: Congressional Budget Office calculations based on Hunter M. Breland, *The SAT Score Decline: A Summary of Related Research* (New York: The College Board, 1987); The College Entrance Examination Board, *National College-Bound Seniors, 1985* (New York: The College Board, 1985); and National Center for Health Statistics, unpublished data.

NOTE: Birth order is inverted so that trends in birth order and SAT scores are in the same direction.

Cross-Sectional Studies. The relationships between family or household composition and various aspects of intelligence and achievement have been noted for at least a century, although the nature of those relationships and their explanations remain controversial to this day. 17/ The association between achievement and the number of children has probably received the greatest attention, but studies of birth order are also abundant, and some prominent analysts have treated the two variables--incorrectly, as is

17. For example, Francis Galton, *English Men of Science* (London: MacMillan, 1874) cited in Joseph Lee Rodgers, "Confluence Effects: Not Here, Not Now," *Developmental Psychology*, vol. 20 (1984), pp. 321-331.

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explained below--as roughly synonymous. Other related changes in family composition have received less attention and are not considered here. 18/

Available research leaves no doubt that the factors termed "family size" in this study, taken together, are associated with achievement in most settings. What remains controversial is which aspects of family size are important and what causes these associations. Without answers to these questions, the contribution of changing family size to recent trends in test scores cannot be accurately assessed.

Most cross-sectional research shows that children from larger families tend on average to leave school earlier and to score lower on intelligence and achievement tests than their peers from smaller families. 19/ This relationship has been found in many different groups in several countries, and it seems to hold true for a wide variety of measures of intelligence, educational achievement, and educational attainment.

The relationship between birth order and achievement is less certain. Studies that attempt to isolate an independent effect of birth order--typically, by examining the relationship between birth order and achievement among families with a specific number of children--are inconsistent. Some studies show an independent negative association between birth order and achievement, while others do not. Some analysts suggest that this inconsistency reflects different effects in different age groups: among older children, later-born children generally score lower than earlier-born, while the pattern among younger children is less clear and may even be re-

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18. One other aspect of family composition that warrants special note is the spacing between births. It has been argued that the effects of birth order and family size are mediated by changes in this factor (R. B. Zajonc, "Validating the Confluence Model," *Psychological Bulletin*, vol. 93 (1983), pp. 457-480). However, research directly assessing the impact of spacing on achievement or IQ (rather than attempting to infer it from data on trends in other family characteristics) suggests that while spacing affects performance, it does not substantially alter the relationship between number of children and performance (see Yvonne Brackbill and Paul L. Nichols, "A Test of the Confluence Model of Intellectual Development," *Developmental Psychology*, vol. 18 (1982), pp. 192-198). Therefore, omitting spacing of births from this discussion should not bias conclusions about the effects of birth order and number of children.

19. For reviews of many of the relevant cross-sectional studies, see R. B. Zajonc, "Validating the Confluence Model"; Judith Blake, "Family Size and the Quality of Children," *Demography*, vol. 18 (November 1981), pp. 421-442; Rodgers, "Confluence Effects: Not Here, Not Now"; and Lala Carr Steelman, "A Tale of Two Variables: A Review of the Intellectual Consequences of Sibship Size and Birth Order," *Review of Educational Research*, vol. 55, no. 3 (Fall 1985), pp. 353-386.

versed. 20/ Not all studies of older children, however, have shown a consistent independent association between birth order and achievement.21/

Researchers have reached fundamentally different conclusions about the causes of these associations between family size and achievement. The primary root of the disagreement is a particularly serious instance of the common problem of confounding. Family size is usually related to other factors, such as ethnicity and socioeconomic status (SES), that are in turn strongly associated with educational achievement. In the United States as a whole, for example, the average number of children per family was roughly 1.8 among whites, 2.2 among Hispanics, and 1.9 among blacks in 1984.22/ Similarly, families with a greater number of children are headed by parents who have on average lower educational attainment and lower occupational prestige. 23/

The extent to which the associations found in cross-sectional studies should be attributed to these confounded factors rather than to family size itself remains a matter of intense controversy. Some researchers argue that apparent effects of family size are primarily consequences of associated

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20. R. B. Zajonc, Hazel Markus, and Gregory B. Markus, "The Birth Order Puzzle," *Journal of Personality and Social Psychology*, vol. 37 (1979), pp. 1325-1341; and Zajonc, "Validating the Confluence Model," Figures 2, 3, 5, and 6.

21. In nationally representative data from the high school senior class of 1972, for example, negative associations between achievement and birth order appear in families with two or three children, but not in those with four or five. See Albert E. Beaton, Thomas L. Hilton, and William B. Shrader, *Changes in the Verbal Abilities of High School Seniors, College Entrants, and SAT Candidates Between 1960 and 1972* (New York: College Entrance Examination Board, June 1977), Table 10. See also Steelman, "A Tale of Two Variables."

22. Department of Commerce, Bureau of the Census, *Household and Family Characteristics: March 1984*, Current Population Reports: Population Characteristics, Series P-20, No. 398 (1985), Table 1. Hispanics are counted twice in these numbers because the Census Bureau asks about race independently of questions on ethnic origin. The average number of children in the "white" category would drop if Hispanics were excluded.

23. Blake, "Family Size and the Quality of Children"; Judith Blake, "A Sociological Perspective on Number of Siblings and Educational Attainment" (paper delivered at the annual meeting of the American Association for the Advancement of Science, May 27, 1985); Brackbill and Nichols, "A Test of the Confluence Model"; Ellis B. Page and Gary M. Grandon, "Family Configuration and Mental Ability: Two Theories Contrasted with U. S. Data," *American Educational Research Journal*, vol. 16, no. 3 (Summer 1979), pp. 257-272; Rodgers, "Confluence Effects: Not Here, Not Now"; and Zajonc, "Validating the Confluence Model."

differences in factors such as ethnicity. 24/ Researchers at the other extreme argue that some sizable proportion of the observed relationships are in fact direct effects of family characteristics. 25/

The likely contribution of changes in family size to the achievement trends of the past two decades hinges largely on the extent to which each of these competing views is correct. To whatever degree family size itself caused the observed cross-sectional relationships, the changes in family size accompanying the baby boom and baby bust should have brought about corresponding changes in achievement, regardless of confounding with variables such as socioeconomic status and ethnicity. If, on the other hand, the confounded variables account for some or all of the observed relationships, the effects of the baby boom would have been that much smaller, because the fertility changes of the baby boom did not cause parents to change in terms of factors such as educational attainment and ethnicity.

Perhaps the only noncontroversial conclusion that can be drawn from this research is that confounded factors account for an appreciable share of the observed relationships between family size and achievement. This conclusion implies that the cross-sectional research overstates the likely contribution of changes in family size to recent achievement trends, but the magnitude of that overstatement remains unresolved.

Temporal Consistency. In certain respects, trends in family size show a remarkable consistency with some aspects of the achievement trends, but in other respects, they are inconsistent. Taken together, the data about temporal consistency certainly do not rule out family size as a contributor to the achievement trends, but they are not nearly as striking or persuasive as some observers have maintained.

As noted above, trends in average birth order show a striking consistency with achievement trends during the later years of the decline and the subsequent upturn. This consistency is not limited to the SAT. Among a variety of tests, the end of the achievement decline and the onset of the subsequent rise in test scores occurred within a few years of the birth cohorts of 1962 and 1963--that is, very nearly at the point at which birth order began falling. On the other hand, trends in birth order are far less temporally consistent with the early years of the achievement decline. The

24. Page and Grandon, "Family Configuration."

25. For example, Blake, "Family Size and the Quality of Children"; and Zajonc, "Validating the Confluence Model."

beginning of the decline did not show a cohort pattern at all, and the birth cohorts that initiated the decline ranged from 1946 (a few cohorts before birth order began to rise) to 1956 (by which time the rise in birth order was nearly over). One possible explanation for this pattern is that trends in birth order contributed to the achievement trends, but that their influence was modest enough to be offset by other factors during the early years of declining scores.

The cross-sectional research, however, suggests that birth order is less important than the number of children per family. Given the constraints of available data, the temporal consistency between number of children per family and test scores is hard to gauge, but it appears not to be as close as that shown by birth order.

At first glance, the trend in the average number of children per family appears to be entirely inconsistent with test score trends. The average number of children rose from about 2.2 in 1953 (the earliest year of data) to about 2.4 in 1965 as a consequence of the baby boom. It has fallen quite consistently since then, although the drop has tapered off recently. By 1984, the average number of children per family was only 1.85. 26/ Thus, the drop--which should have raised test scores--continued almost without interruption during the entire period of the test score decline and began to abate only recently, at a time when test scores were generally rising.

In fact, however, trends in the number of children per family are not as inconsistent with achievement trends as they first seem. The trend data about the number of children per family discussed in this analysis were obtained by surveys that inquired about all children under age 18 living in the household at the time of the survey (in March of every year). Each year's average thus reflects children of 18 different ages--that is, 18 different birth cohorts, ranging from the cohort born in the year of the survey to that born 17 years earlier. When the average number of children per family reached its peak in 1965, for example, that year's data reflected cohorts born from 1948 to 1965.

Data on the average number of children per family in any given year therefore cannot be tied to individual birth cohorts. As long as the average number of children per family is changing, each of the cohorts reflected in a given year's data will experience a different history of family sizes over the course of their childhoods. For example, the birth cohort of 1953 exper-

26. Department of Commerce, Bureau of the Census, published and unpublished tabulations of the March Current Population Survey.

ienced increasing family sizes--from 2.2 to 2.4 children, on average--during the first 12 years of life. From then until age 18, they experienced the rapid decline in family size--from 2.4 to 1.9 children, on average--that appears in the survey data beginning in 1965. In contrast, the birth cohort of 1965 experienced that same decline in family size during the early years of childhood.

Because the simple trend in the average number of children reflects children of all ages who experienced the change for varying lengths of time and at different periods in their childhood, it does not provide the information needed to gauge the contribution of family size to trends in test scores. Instead, one needs data indicating the number of siblings present in the home of children throughout their childhoods, as well as a model indicating which periods of childhood are most susceptible to the influence of family size. These data do not exist. Moreover, they cannot be derived easily from the available information about family size at specific points in childhood, such as birth order (which is closely related to the number of siblings present at a child's birth) or the number of siblings present at the conclusion of schooling. 27/

If the ideal data were available, however, they would probably be more consistent with trends in test scores than is the trend in average number of children. The ideal measure for high school seniors, for example, would probably predict a gradually growing, positive effect of family size on test scores that became substantial either in the later years of declining test scores or during the period of rising scores. To understand this, consider the experience of successive cohorts of 17-year-old students as the average number of children per family fell. When the decline in fertility caused the average number of children to begin falling in the mid-1960s, the cohort that was then age 17 would have been little affected. The number of 17-year-olds with newborn siblings would be changed very little, and for the few whose circumstances were altered, the change would be confined to the last year of childhood. With each passing year, the number of 17-year-olds influenced by the change would grow, and the portion of their childhood affected would increase.

Direct Estimates of the Impact of Changing Family Size. Studies based on data about individual students in affected cohorts suggest that trends in birth order and number of children per family produced only a small to moderate share of the test score decline. Moreover, these studies, like the

27. For example, for the next-to-last-born of 10 children, the average number of minor children present at age 17 is two--hardly an accurate indication of the family configuration experienced by that child during most of his or her childhood.

cross-sectional studies mentioned earlier, overstate the independent effects of changes in family size, because they failed to take into account the effects of confounded variables such as socioeconomic status and ethnicity.28/ No studies to date have used individual-level data to estimate the contribution of these trends to the subsequent rise in scores.

One study that examined changes in birth order in the entire age cohort estimated that between 1964 and 1976, changes in birth order would have produced a drop of 6.3 points on the SAT-Verbal--about 15 percent of the total observed decline. 29/ A shorter-term but more detailed study examined changes in both number of children and birth order among students actually taking the SAT. That study estimated that between 1970 and 1976, roughly 4 percent of the decline on the SAT-Verbal and 9 percent of the drop on the SAT-Math could be attributed to changes in these factors.30/ The proportion of the decline attributable to these factors might have been greater, however, among all students than it was among those taking the SAT. One study found that between 1959 and 1971, about 25 percent of the decline in reading achievement among all seniors could be attributed to changes in number of children and birth order, compared with 9.5 percent of the decline on the SAT-Verbal. 31/

Conclusion. Given the inconsistencies in the research discussed above, it is perhaps not surprising that analysts have reached sharply different conclusions about the contributions of family size to the recent trends in test scores. If one focuses on birth order, one finds clear temporal consistency with trends in test scores for about two decades (though inconsistency in earlier years), but ambiguous cross-sectional research. The evidence per-

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28. One of these studies attempted to remove the effects of one aspect of socioeconomic status - - family income (R. B. Zajonc and J. Bargh, "Birth Order, Family Size, and Decline of SAT Scores," *American Psychologist*, vol. 35 (July 1980), pp. 662-668). Removing that one factor, however, is insufficient to ascertain how much the estimated effects of family size--small in any case in that study--would have been lessened if ethnicity and more varied indicators of socioeconomic status had also been examined.

29. H. M. Breland, *Family Configuration and the Decline in College Admissions Test Scores: A Review of the Zajonc Hypothesis* (New York: College Entrance Examination Board, January 1977).

30. Zajonc and Bargh, "Birth Order, Family Size, and Decline of SAT Scores."

31. Beaton and others, *Changes in the Verbal Abilities of High School Seniors*, pp. 5, 31, and 57. The proportionately lesser impact of these changes on average SAT scores might reflect the major compositional changes affecting the SAT during those years. Those compositional changes presumably contributed more to the total decline on the SAT than to the amount of the SAT decline attributable to changes in family size.

Many studies have found that high levels of television viewing are associated with lower levels of educational achievement. 42/ Whether television viewing actually causes lowered achievement, however, remains a matter of debate, although several recent studies suggest it has a negative effect on reading. This uncertainty stems in part from the difficulty of accounting for the effects of confounding variables--in this case, not only demographic and socioeconomic factors but also differences in intelligence-test scores of students watching dissimilar amounts of television. In addition, most American children watch a great deal of television, and this "restriction of range" in the amount of viewing probably attenuates estimates of television's effects. 43/

If the effects of television viewing on achievement are actually small, it might be because the activities from which television "steals time" are no more conducive to educational achievement than is TV viewing itself. The soundest studies of TV's effects on children's use of time, most of which unfortunately were conducted between 25 and 40 years ago and therefore reflect a much lower level of viewing than is currently the norm, suggest that the "activities most often replaced (by television) are those that can be considered functionally equivalent." When children increased their viewing of television, they reduced primarily the time they spent watching movies, listening to the radio, reading comic books, and playing with others. 44/ Among older children, very little time was taken from homework or reading books and magazines.

Whatever TV's effects on achievement in general, the timing of changes in the amount of viewing suggests that they were not an important influence on the aggregate achievement trends of the past two decades. Average viewing time in the mid-1970s was roughly comparable to that a decade earlier, at the onset of the decline (see Figure A-2). Viewing increased during the late 1970s, but the increases were larger in the younger age groups, among whom the achievement decline had already ended. The

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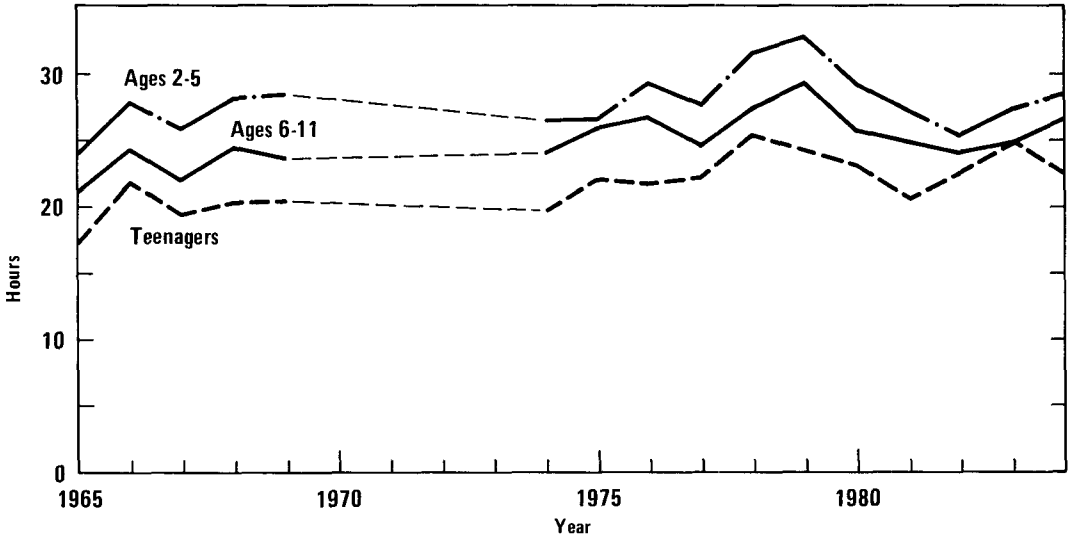
42. This section is based in large part on two recent reviews: Robert Hornick, "Out-of-School Television and Schooling: Hypotheses and Methods," *Review of Educational Research*, vol. 51 (Summer 1981), pp. 193-214; and Michael Morgan and Larry Gross, "Television and Educational Achievement and Aspiration," in David Pearl, Lorraine Bouthilet, and Joyce Lazar, eds., *Television and Behavior: Ten Years of Scientific Progress and Implications for the Eighties, Volume II--Technical Reviews* (Rockville, Md.: National Institute of Mental Health, 1982), pp. 78-90.

43. The severity of this last problem is indicated by one study that found that only two percent of students reported watching less than one hour per night.

44. Hornick, "Out-of-School Television and Schooling," p. 200.

Figure A-2.
Television Viewing by Children, by Age (Average hours per week)



SOURCE: Congressional Budget Office calculations based on A.C. Nielsen Co. unpublished data.
NOTE: Comparable data are not available for 1970 through 1973.

subsequent decline in viewing started at the end of the decade, at about the time that senior-high test scores started rising, but the drop lasted only a few years. Over the past several years, viewing has again increased, while tests scores at all grades have continued to climb.

Although the amount of viewing could not have contributed significantly to aggregate trends in test scores, changes in the content of the material viewed could nonetheless be germane. The available data do not permit assessing this hypothesis, however.

Students' Attitudes and Motivation

Changes in students' attitudes and motivation are among the most frequently cited explanations of the achievement decline. The Advisory Panel on the Scholastic Aptitude Test Score Decline, for example, referred to the late 1960s and early 1970s--the core years of the decline among high school seniors--as a "decade of distraction," a time when "national disillusionment" arose from the divisive Vietnam War, political corruption, assassinations, and large-scale urban riots. The Panel, noting that the students taking the SAT during the period of its sharpest decline had already experienced this social upheaval for five or six years and that some male students faced the

prospect of the military draft after completing school, suggested that this may have negatively affected students' motivation and attitudes toward educational success. 45/ Other social trends of the period might reflect changes in attitudes that could also affect achievement--for example, the changes in drug use noted above, and the trends in suicide, homicide, and arrest rates among young people noted in Chapter IV.

This explanation appears to be among the most plausible. It fits many aspects of the achievement trends quite well, such as their timing; their remarkable pervasiveness among different types of students, schools, geographic areas, and subject areas; the existence of a subsequent upturn; and the fact that the decline was greater among older students. It is precisely the sort of broad societal change that could dramatically affect student achievement; at the same time, it is also consistent with many observers' accounts of the period.

On the other hand, this explanation seems impossible to test. In asserting the importance of attitudes and motivation, the Advisory Panel maintained that "the facts are as obvious as the proof of any causal relationship is impossible." Even that statement understates the difficulty of appraising the impact of these factors, for the "facts," however obvious, are hard to document systematically. Nationally representative surveys of students provide measures of attitudes and motivation, but the available data are both sparse and inconsistent. Between 1971 and 1979, for example, the proportion of high school seniors responding that their schools "should have placed more emphasis on basic academics" grew markedly--from roughly half to three-quarters. 46/ Some observers have taken this as a sign that students' interest in academic success remained high and that a decrease in the demands imposed by their schools made it harder to attain their desired level of achievement. Other results of the same survey, however, are inconsistent with this interpretation; for example, the proportion claiming that their courses were too hard increased from roughly 42 percent to 49 percent.

Lacking firsthand, systematic evidence, some analysts have used other educational trends as circumstantial evidence of relevant trends in students'

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45. Advisory Panel on the Scholastic Aptitude Test Score Decline, *On Further Examination* (New York: The College Entrance Examination Board, 1977), p. 37.

46. W. B. Fetters, G. H. Brown, and J. A. Owings, *High School Seniors: A Comparative Study of the Classes of 1972 and 1980* (Washington, D.C.: National Center for Education Statistics, undated), Table 2.7.

attitudes and motivation. Examples include grade inflation (an easing of the requirements for obtaining high grades) and the growth of "social promotion" (the promotion into higher grades of students who have not adequately mastered the material required in their present grades). It is unclear what these trends imply, however; they could be either effects or causes of relevant changes in students' attitudes and motivation, or they could be largely unrelated to them.

Trends in school attendance have been used as an indirect indicator of attitudes and might also be important as a measure of the total amount of schooling obtained. A major early review of the achievement decline argued that a drop in attendance was concurrent with the beginning of the decline and might have contributed to it. 47/ While changes in absenteeism are to some extent consistent with the achievement trends at the senior-high level, however, they have been slight. In the 1980 school year, for example, average daily attendance was 90 percent of school-year enrollment--the same as in 1959. Moreover, during this period, attendance was never more than 1.4 percentage points above or below 90 percent. 48/

Trends in the enrollment of senior-high students in academic and nonacademic programs might also reflect changes in student motivation and might be one of the mechanisms by which motivational trends affect test scores. In the senior class of 1972, 46 percent of all students were enrolled in academic programs; in the class of 1980, only 38 percent. Most of the corresponding increase was in "general" rograms, although enrollments in vocational programs also grew a bit. While the cause of this change remains obscure, the fact that the shift out of the academic track was about twice as large among males as among females and that the relative growth in vocational enrollments only occurred among males suggests that these changes were in substantial part voluntary and, therefore, that students' attitudes and motivations might have played some role. 49/

Environmental Lead

Possible environmental explanations of the achievement trends have as yet generated relatively little attention, and information about them is typically

47. A. Harnischfeger and D. E. Wiley, *Achievement Test Score Decline: Do We Need to Worry?* (Chicago: CEMREL, Inc., 1975).

48. Center for Education Statistics, published and unpublished tabulations.

49. Fetters and others, *High School Seniors*, Table 2.1.

sparse. 50/ The research on the effects of environmental lead, summarized here, is unusually plentiful. It is important, not only because of the possible effects of lead itself, but because it illustrates the more general point that neither environmental factors nor students' health should be summarily ruled out as influences on trends in test scores.

The serious neurological effects of lead poisoning--which include gross impairment of both motor control and cognitive functioning, lethargy, convulsions, and even coma and death--have been documented for at least a century and a half. 51/ In addition, lead is widespread in the human environment because of lead-based paint, leaded gasoline, emissions from lead smelters, batteries, and other sources.

Existing research indicates that the exposure of many American children to lead has been sufficient to impair their cognitive functioning in ways that could affect performance in school. Individuals with levels of lead burden well below those that cause classic lead poisoning have shown lower scores on intelligence and other cognitive tests, poorer performance on perceptual-motor tasks, various disruptions of the functioning of the nervous system, and disturbances of attention. Children seem to be more susceptible to these effects than adults. Significantly, some of these problems are apparent in teachers' ratings of students with elevated levels of lead in their blood, suggesting that the symptoms appreciably interfere with students' functioning in school.

A considerable amount of the available research explores the effects of lead on performance on intelligence quotient (IQ) tests; the scores on these tests are highly correlated with those on many achievement tests. The research as a whole suggests that the IQ scores of children with notably elevated levels of lead in their blood (from 30 micrograms per deciliter to 70 micrograms per deciliter) but with no overt symptoms of lead poisoning appear to be depressed by 4 to 5 points--that is, by a fourth to a third of a standard deviation. Results of research about the effects of lesser exposure are less consistent, but some studies suggest a decrement of 1 to 2 points--0.07 to 0.13 standard deviation--at blood lead levels of 15 to 30

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50. For a review of some environmental explanations, see B. Rimland and G. Larson, "The Manpower Quality Decline: An Ecological Perspective," *Armed Forces and Society*, vol. 8, no. 1 (Fall 1981), pp. 21-78.

51. A comprehensive review of the research on environmental lead, including a thorough discussion of methodological problems and gaps in existing data, can be found in Environmental Protection Agency, *Air Quality Criteria for Lead*, draft final version (Research Triangle Park, N.C.: Environmental Criteria and Assessment Office, June 1986).

micrograms per deciliter. Negative effects of lead on IQ are evident across the entire range of IQ scores. 52/

Although only a modest proportion of children have blood lead levels in the "notably elevated" range, many exceed 15 micrograms per deciliter and therefore may have appreciably depressed IQ scores. A national study in the late 1970s, for example--when exposure had already dropped considerably from earlier levels--found that 4 percent of children below age 6 had levels above 30 micrograms per deciliter, and almost 25 percent exceeded 20 micrograms per deciliter. Indeed, the average level among children under age 6 was about 15 micrograms per deciliter, and among older children it was about 12 micrograms per deciliter. 53/ Among certain groups--blacks, low-income children, and children in large metropolitan areas, for example--exposure is considerably greater yet. 54/

Recent data, though relatively sparse, consistently show a sharp decline in levels of lead in the blood that appears to reflect the reduction in the use of leaded gasoline. A large, nationally representative study found a drop in lead levels from 1976 to 1980 ranging from 31 percent to 42 percent. This reduction appeared in all age groups but was somewhat greater among children than adults. Other data from screening programs in individual cities show declines in lead levels of newborns and preschool children, in one case beginning as early as the late 1960s.

Although these drops in lead levels occurred in cohorts that produced rising test scores, gauging the temporal consistency of the two trends is difficult. One obstacle is that academic performance might be partly determined by past levels of lead exposure as well as current lead burden, because the effects of both lead exposure and education are cumulative. The absence of nationally representative data on lead burdens earlier than the mid-1970s is also problematic.

Although the effects of lead on the cognitive abilities of individual children can be large, any contribution of declining lead exposure to the aggregate rise in test scores would probably have been small. By way of

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52. Ibid., vol. 1, p. 117, and vol. 4, pp. 12-86 and 12-95. Although early epidemiological studies of the effects of lead exposure have been criticized because of confounding with social class and other factors, recent reanalyses and studies appear to confirm that the relationships with cognitive functioning reported here are not an artifact of confounding.

53. Ibid., vol. 4, p. 11.16.

54. Ibid., vol. 4, pp. 11.15 and 11.20.

comparison, the IQ decrement of children with notably elevated levels of lead in their blood appears to be nearly as large as the average decline in achievement test scores in grades 6 through 12 and is larger than the increase to date shown by many tests. But, as noted earlier, few children have blood lead levels in the notably elevated range. Moreover, only changes in lead burden could have contributed to trends in test scores; stable, high levels of exposure could cause the average score to be lower than it would otherwise be but would not produce a change over time. Because lead exposure was substantial before the achievement decline and remains sizable today, the total change in lead exposure during the period in question was undoubtedly smaller than the highest levels of exposure reached during those years.

EDUCATIONAL FACTORS

Although educational changes have figured prominently in public discussion of the possible causes of the recent trends in test scores, systematic evidence supporting such a contribution is available for only a minority of the educational factors examined in this study. The available data contradict several common hypotheses and are simply inadequate to evaluate numerous others. 55/

Teachers' Skills and Experience

Few aspects of the educational system have been as central to the current debate as the quality of the teaching work force. Appraising the possible effects of teachers' characteristics on average test scores is impeded, however, by the remarkable inconsistency of much of the relevant cross-sectional research. The findings of many studies are statistically insignificant--that is, they might well be the result of chance. Furthermore, the few significant findings are often contradictory.

Teachers' Test Scores. Students intending to become teachers obtain, on average, relatively low scores on achievement tests, and their scores dropped more rapidly than those of students in general during the latter part

55. A number of educational factors that have figured prominently in the recent debate about achievement have been omitted from this section because they are not widely thought to have been causes of the specific test score trends analyzed in this study. Examples include the rise of real expenditures for education and the fall of pupil/staff ratios, both of which continued during the period of declining test scores.